$2.50

44

Popular Computing

November 1976 Volume 4 Number 1

N	V	V mod 3	V mod 5	V mod 7
1	0	0		
2	1		1	
3	3			3
4	7	1		
5	9		4	
6	14			0
7	15	0		
8	16		1	
9	18			4
10	23	2		
11	26		1	
12	28			0
13	29	2		
14	32		2	
15	35			0
16	36	0		
17	37			

K-Moduli Sequence

Contest 13

PROBLEM 143

Contest 13: K-Moduli Sequence

The sequence shown on the cover is generated in the following manner. Term 1 has the value zero. That value, taken modulo 3, dictates how many integers to skip to get the next value, which is thus <u>one</u>.

That value, 1, taken modulo 5, dictates how many integers are to be skipped to get the value for the third term; namely, 3. The next step uses that 3, taken modulo 7. The three moduli (3, 5, and 7) are taken in rotation, and the procedure continues indefinitely.

The sequence of V values increases by about 3 per term. The ratio of V to N (N is the term number) is 3.05714 at term 70 (V is then 214) and this appears to be the highest that that ratio gets.

If the generating scheme is extended to use moduli of 3, 5, 7, and 11 in rotation, the ratio of V to N appears to peak at term 81 (V is 334, the ratio is then 4.123456).

And if the moduli are 3, 5, 7, 11, and 13 (taking successive odd primes), the peak for the ratio is 4.425249 at term 301 (V is 1332).

Similarly, with 6 moduli (3, 5, 7, 11, 13, and 17), the peak for the ratio is 5.806452 at term 31 (V = 180).

We thus have this table:

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Number of moduli	Term number	V	V/N
3	70	214	3.057143
4	81	334	4.123456
5	301	1332	4.425249
6	31	180	5.806452

This table is to be extended, with the additional moduli taken as 19, 23, 29, 31 (consecutive primes) and so on. For the longest list of new entries to the list we will extend our usual $25 prize.

For each additional line of the table, it is necessary not only to generate the sequence, but to establish (either emprically, or by analysis) that the peak value of the ratio V/N has been attained.

For checking purposes, the first 50 terms of each new sequence should be shown.

Entries to this contest must be received by January 31, 1977. Address POPULAR COMPUTING, Box 272, Calabasas, California 91302.

PROPRIETARY SOFTWARE

With programmable calculators now becoming widely used, it is not too surprising that proprietary software for this market area has arrived. A program for the Texas Instruments' SR-52 to solve 5 simultaneous linear equations is offered by

C. B. Coleman, Jr.
419 Shields Drive
Anaheim, California 92804

for $6, including a 15 day trial period. The package is actually three programs, of which the first accepts the 30 coefficients and reduces the system to 4 x 4; the second then reduces the system to 3 x 3; the third then solves the 3 x 3 system and outputs four of the roots (the 5th root is readily obtained from any of the original equations). The determinant of the matrix is obtainable as a by-product. The package is carefully documented, including test cases.

18 SYMPOSIA

In 1958, it was observed that the really interesting part of computing conventions was not the formal talks but the informal discussions in the hotel lobbies and on the exhibit floor. Moreover, the information gathered in the informal discussions was current; the formal talks tended to be a year or more out of date. The way to find out what was going on in the computing world was to find the right group and infiltrate it. Thus an idea emerged: why not go at this up-to-date exchange of ideas systematically?

A group of 12 experts was invited to spend a day at the RAND Corporation to discuss current topics in the field. The discussion was taped, and a transcript of the session was produced. In those days we had an East and West Joint Computer Conference. By tacking this symposium on to the week of the Western conference, it was feasible to get nearly anyone we wished to have attend, since they were already committed to traveling to or near Santa Monica.

The affair was repeated year after year, winding up in New York City in 1976 where the last such session was held. It seems reasonable to quit while we're ahead; to bow out gracefully, before the act gets too stale.

It took us several years to get the mechanics of the affair just right. To be productive, the invited group must be fairly homogeneous; that is, it is necessary that no person dominate the group or feel dominated. Thus, attempts to liven things up by injecting promising youngsters into the groups always failed; the youngsters promptly shut up and failed to contribute. How talkative would you be in the same group with, say, J. Presper Eckert, or Herb Grosch, or Dick Hamming?

Then there is the matter of the critical mass. If you want constructive give-and-take, the group must be the right size. Too few (say, less than 12), and it becomes a bull session, unstructured and free wheeling. Too many (say, over 15), and it becomes formal, and people tend to give speeches. The right size is around 13, counting the chairman, whose job is to maintain order and gently guide the group into fruitful channels.

Even given the right size of the group, and as homogeneous a group as possible (the latter quality being hard to predict, much less control), it is then necessary to achieve a level of mutual disrespect, which means about an hour at the start of each session in which the attendees can throw verbal rocks at each other before getting down to the business at hand.

Which is another thing: there should be some business at hand. Ideally, there should be a single burning topic, such as "The Future of Programmers" at the 1974 session. A mixed bag of small topics will work, but not as well.

In the early days, the sessions were recorded on studio equipment: quarter inch full track tapes, 3600 feet long, 15 inches per second, to be played back on a semi-portable Magnecord, which was messy. The shift to portable cassette recorders in 1969 was quite an advance (and produced clearer recordings, too).

The first eleven sessions were held at RAND; sessions 12 through 18, sponsored by California State University, Northridge, were held wherever that year's computing conference happened to be. One memorable session was held in Mexico City in 1970, co-hosted by Sr. Sergio Beltran. Perhaps the single most productive discussion was in 1959, when the general outline of an organization resembling AFIPS was developed.

In 1968, the topic was "How Go the Societies?" and the group was made up of the operating officials of the larger groups in AFIPS (ACM and IEEE primarily). As it turned out, these people knew of each other, but had never met. Common problems and solutions were discussed, and it was generally agreed that much was accomplished. It was also agreed that the transcript of that session should be kept under wraps, since a lot of dirty linen was washed in public.

Actually, not much was accomplished by that day's discussion. The 1975 session had the topic "The AFIPS Societies Revisited" and we went over the same ground again (but with a new cast, and with more societies represented). It seems that pious thoughts don't always get translated into pious actions. By 1982 it will be time to do it once again.

The production of the printed transcript is an unusual task, taking about 7 hours per hour of the original tape. No one talks in written English (although some people are far better than others at it). A very high percentage of the information transmitted lies in the tempo and pitch of the speaker, plus the motions of his body, arms, and eyebrows. The translator of the tapes must understand the conversations and must have been at the session. A verbatim transcript would be pure gibberish.

One topic came up every single year; namely, What are the gourdheads in the universities doing to furnish trained and educated people for our field? There was always the implication (come on!--they came right out and said it) that if only the professors would shape up, the university output would be semi-employable. Three facts never seemed to register on the industry people:

1. They took 20 years to learn what they knew, and they had learned almost all of it the hard way.

2. The total classroom contact with even a computer science major is around 200 class hours, during which time all the basics must be taught. 2000 hours would be more like it, to produce a product that would please everyone.

3. The yield is extraordinarily low. Of every 100 students who present themselves to be taught computing (or data processing, if you will), perhaps four will catch on within two years to what it's all about.

The 1976 swan-song session had the topic "What Will Computing be Like 30 Years From Now?" The prevailing mood went from optimistic to pessimistic every half hour or so for a 9-hour session. The optimism came from some signs that our discipline is maturing. One of these signs is the appearance within the last year of half a dozen really outstanding books, all of them with the underlying theme that our trade should become organized and orderly, and that we now know how to do that. The pessimism came from the explosion of the mini and micro machines, and the awareness that the users of those machines are doing exactly what everyone else did in 1956; namely, making all the old mistakes all over again--and bragging about it.

In 18 sessions, 220 people attended (not including in that count the author and co-host Paul Armer, both of whom were at every session). Some were repeaters, so the number of different people was 178. Within our field, it's a star-studded list.

DATAMATION magazine published the complete transcript of the 1959 session, and excerpts of two others. The 15th symposium (Exploring the Future) was excerpted in our issue number 22. The 16th session (The Future of Programmers) appeared in our issue 28. Excerpts from the final session will appear at a later date.

By and large, though, the discussions were of value only to the participants themselves. The transcripts tend to be dull reading (with occasional lively interchanges) unless you were there. The real value of the 18 years of work lay in the opportunity for contact among peers, and the excitement of being able to bounce ideas back and forth in a highly receptive atmosphere.

Perhaps the idea of these sessions should be continued, but now with the new generation of experts. Us old-timers like to reminisce about how things were with the 701 (or even the RAYDAC), and how everything is going to pot today. If such annual sessions were to continue, it would be only a short time before the attendees would bring along their own pocket computers to bolster their arguments, and the prospect is too outlandish to contemplate.

--fg

AUTOMATED MASTERMIND

The Sum Fun Puzzle Club, Box 1188, Fremont, California 94538, has published a booklet, "Logic," that turns the game of Mastermind into a game of solitaire.

Any of the six letters A-F may be in any of four positions as a hidden pattern, such as

<u>F</u> <u>A</u> <u>B</u> <u>E</u>

Then each try in the game, such as

<u>A</u> <u>B</u> <u>C</u> <u>D</u>

may be looked up in a table; in the example, this produces 61. A second table then shows that for the number 61 the reponse is 02, indicating no letters in the correct position, and two letters guessed correctly. A second guess of CDBA shows 32 and the auxiliary table shows 11; namely, one letter correct in the right position, and one letter correct but in the wrong position. The game continues, using the same logic as in Mastermind or as in Guessword Puzzles (for the latter game, see the writeup in PC35-14).

The booklet contains 20 of the hidden patterns, and the complete trace of (6x6x6x6 = 1296) trial patterns. The 77-page booklet (8 1/2 x 11) is well printed and sells for $2.

Book Review

THE THINKING COMPUTER; MIND INSIDE MATTER

by Bertram Raphael
W. H. Freeman and Company, 1976, 322 pages, $6.95

Raphael's book is difficult to classify (although it contains a lucid section on the subject of classification). It is first of all a comprehensive survey of where we stand today with computers; that is, the limits of our capability in a broad spectrum of endeavors. It is a book about computers and computing, with its greatest emphasis on problem solving. Since Dr. Raphael is the director of the Artificial Intelligence Center of the Stanford Research Institute, he is properly concerned with the artificial intelligence aspects of computing and with robots, and devotes considerable space to those topics.

The book covers a wide range of topics, most of which should be familiar to computer users, but presented here in sensible order and explained with unusual clarity. Some of these topics are:

- Natural language translation
- Game playing
- Analysis of cryptarithmetic problems (cryptarithms)
- Theorem proving
- Picture processing
- Programs that converse (e.g., ELIZA)

The treatment of all topics is generally at a low enough technical level to permit either light reading or detailed study; the reader is not assumed to know calculus or, for that matter, any of the details of computer programming or computer jargon. The book is profusely illustrated, and many of its illustrations are not readily available elsewhere.

The Preface states: "(The book) might be used in the second (and perhaps final) course about computers in a general college curriculum, following a more conventional introduction to computers or data processing; alternatively, it might be used in an early course of a more-specialized, technical sequence." This reviewer agrees. Its content should be given to all students of computing, to provide an intelligent overview of the field as it stands today. Most of the material in the book will still be valid a decade from now. □

STILL MORE ON BRACKETING

The bracketing process has been discussed previously in issues 35 and 39. The process is particularly useful for finding the roots of a function in situations where other algorithms (e.g., interval-halving, or the Newton-Raphson scheme) are messy. The essence of the logic is as follows:

1. The range containing the root must be known and delimited.

2. This range (the solution space) is explored in large steps, with the function evaluated at each step. (The flowchart notation is X+D replaces X; D is the increment.)

3. Some logical test must exist to determine that the root has been passed, or has been found.

4. When the root has been passed, the value of the independent variable is reduced (that is, back off one or more full steps). The increment is cut down, say by a factor of 10. (D/10 replaces D.) Tally one probe. Test for the number of such probes. When the number of probes reaches a predetermined limit, the root being sought has been isolated to the desired level of precision.

5. If the limit has not been reached, return to step 2 and continue.

None of this must be done blindly--the nature of the function involved is critical to the details of the bracketing process.

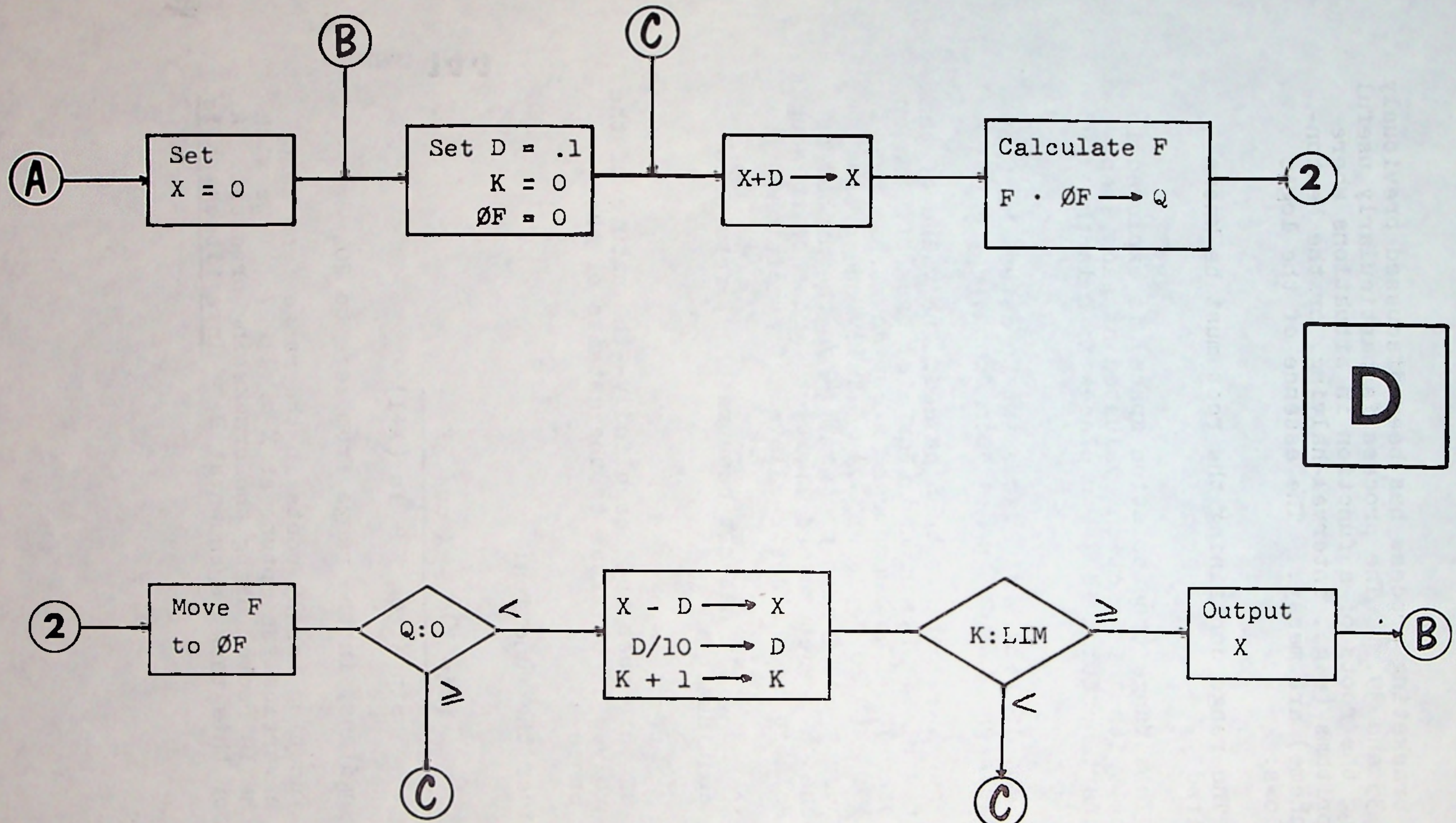
Consider the function:

$$Y = \frac{(\sin X)^3 - X \cos 3X}{\sin X \log X + \ln (X+1)}$$

with X, in radians, in the range from zero to 20.

This function has 19 roots in the range from zero to 20, and a vertical asymptote at X = .11227. We wish to locate the 19 roots, using the bracketing process. A flowchart for this task is shown at D. <u>This flowchart is faulty</u>.

PROBLEM **144**

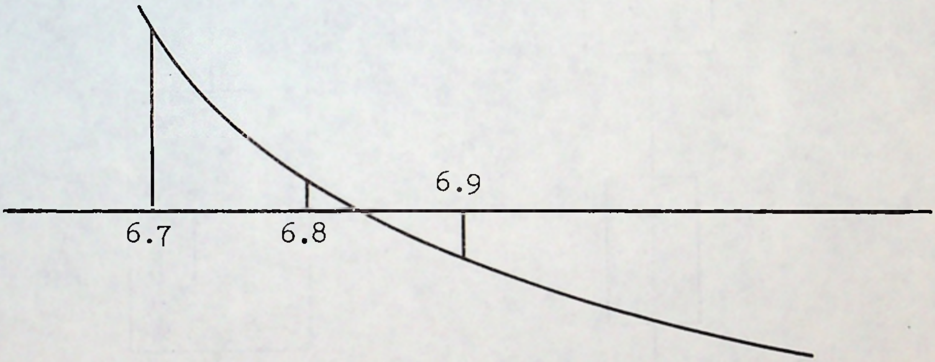


A first try at the bracketing process

THIS FLOWCHART IS FAULTY

If the logic of flowchart D is implemented on a computer, the program will do curious things. Some of the roots will be located correctly; some will be skipped. Moreover, if the value of LIM is changed (say, from 4 to 8), the action will change. Before looking ahead at a correct version of the logic, the reader might try to find the flaws in the logic of flowchart D.

The flowchart seems sensible at first, since it follows the usual bracketing scheme. The value of X increases at first by .1. For each value of the function, F, the product of F and its predecessor, OF, is tested against zero. When the product goes negative, the function has crossed the axis, and a root has been isolated. Back off, cut down the increment by a factor of 10, and search further. But the following situation arises:



At 6.9, the product of F and OF is negative. We back off to 6.8 and recalculate. But now the product of F and 6.8 and OF at 6.9 is again negative, and the logic tells us to back off again, where we should be going forward.

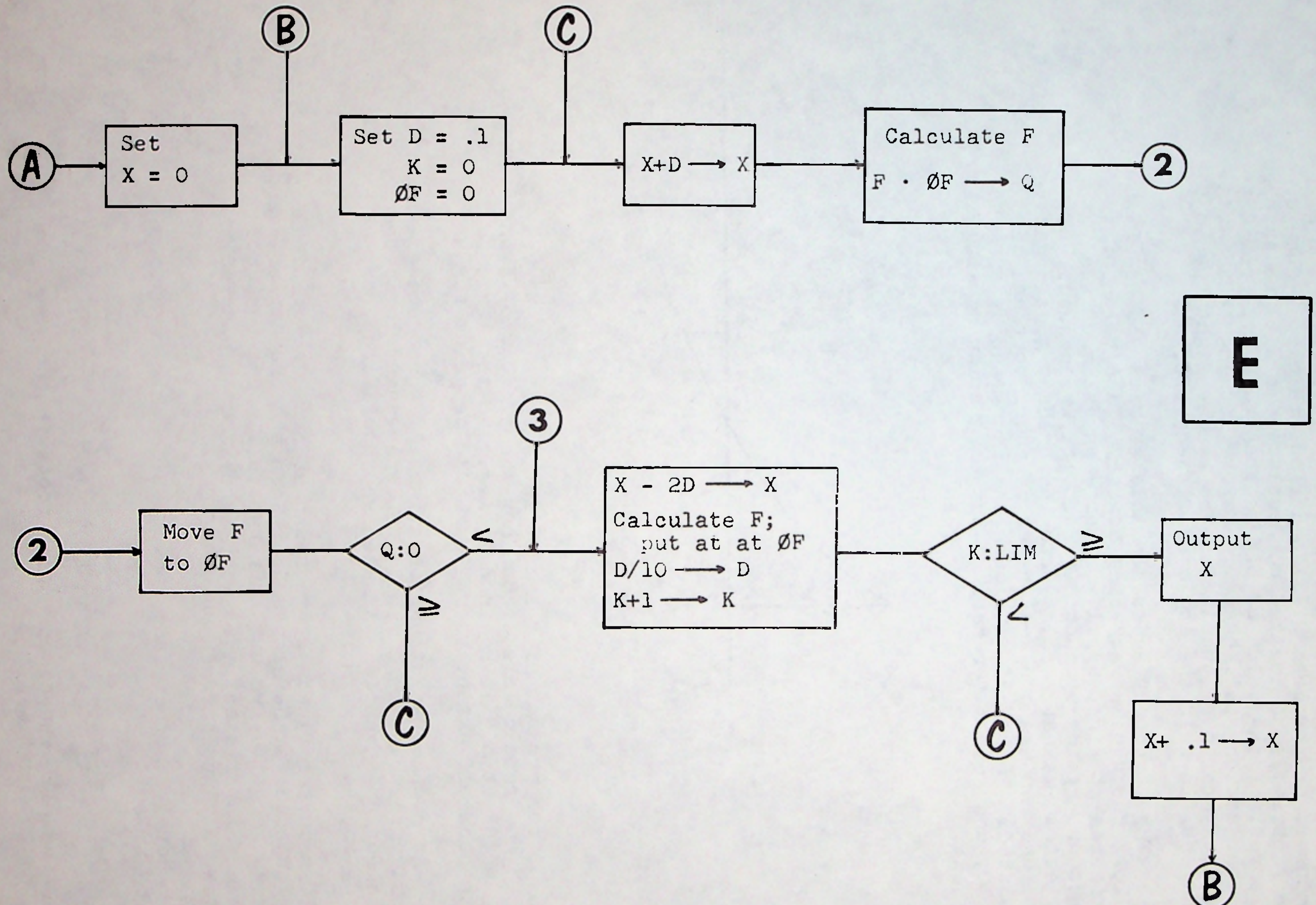
An even worse situation arises if the process actually stumbles on a root. The flowchart logic then calls for an advance in X, when we should stop, or, at worst, back off again.

A better flowchart is shown at E. The critical changes occur at Reference 3. When the product of F and OF goes negative, we back off <u>two</u> full steps (which is somewhat inefficient, but very safe) and then calculate at that X value a fresh value of OF.

Here's another function on which this technique can be tried:

$$Y = \sin\sqrt{X}\ \cos\sqrt{2X+1}\ \sin\sqrt{3X+2}\ \cos\sqrt{4X+3}$$

which is well behaved and has 7 roots in the range from zero to 20 (radians).


A
Set
X = 0
B
Set D = .1
K = 0
ØF = 0
C
X+D → X
Calculate F
F · ØF → Q
2
E
2
Move F
to ØF
Q:0
<
≥
C
3
X - 2D → X
Calculate F;
put at at ØF
D/10 → D
K+1 → K
K:LIM
≥
<
C
Output
X
X+ .1 → X
B

K-COLUMN FIBONACCI

Our 9th contest problem, in the July issue, was the K-column Fibonacci problem. The following comments on the problem are from contributing editor Thomas R. Parkin.

Let us consider the 2-column case, and express it symbolically as follows:

i	a_i	b_i
0	1	1
1	1	2
2	3	4
3	6	9
4	3	9

The initial conditions are circled. We now have

$$b_i = a_i + a_{i-1} \pmod{10}$$

$$a_i = b_{i-1} + b_{i-2} \pmod{10}$$

as the rules for extending the sequences.

Since we know b_i in terms of a_i, we can substitute into the second equation, thus:

$$a_i = a_{i-1} + a_{i-2} + a_{i-2} + a_{i-3} \pmod{10}$$

$$\text{or} \quad a_i = a_{i-1} + 2a_{i-2} + a_{i-3} \pmod{10}$$

This can also be written as:

$$a_{i+3} = a_{i+2} + 2a_{i+1} + a_i \pmod{10}$$

$$\text{or} \quad a_{i+3} - a_{i+2} - 2a_{i+1} - a_i = 0 \pmod{10} \qquad \text{(A)}$$

This last equation is a homogeneous, third order, linear difference equation with constant coefficients, and as such has an elementary solution; that is, one involving algebraic, trigonometric, and exponential functions. Unfortunately, the characteristic equation:

$$m^3 - m^2 - 2m - 1 = 0$$

has no integral or rational solutions; hence the solution is very messy indeed, but there is a solution.

To illustrate how complicated the solution to equation (A) might get, let us back up to the 1-column case, which is the units position of the Fibonacci sequence itself. Here we have:

$$a_{i+2} - a_{i+1} - a_i = 0 \qquad \text{(B)}$$

and the characteristic equation is $m^2 - m - 1 = 0$. This equation has the roots

$$m_1 = (1+\sqrt{5})/2, \quad m_2 = (1-\sqrt{5})/2$$

and we can write the solution to (B) as:

$$F_i = f(i) = C_1\left[(1+\sqrt{5})/2\right]^i + C_2\left[(1-\sqrt{5})/2\right]^i \qquad \text{(C)}$$

according to difference equation theory which gives us that form for the general solution to a second order, linear difference equation with constant coefficients. Since a second order system requires two initial conditions, and we have the usual definitions for the Fibonacci sequence:

$$f(0) = 0 \quad \text{and} \quad f(1) = 1$$

then, when we substitute these and solve for the two arbitrary constants, C_1 and C_2, we have:

$$C_1 = 1/\sqrt{5} \quad \text{and} \quad C_2 = -1/\sqrt{5}.$$

Thus, we can write the particular solution to (B) as:

$$F(i) = f(i) = \frac{1}{\sqrt{5}}\left(\frac{1+\sqrt{5}}{2}\right)^i - \frac{1}{\sqrt{5}}\left(\frac{1-\sqrt{5}}{2}\right)^i \qquad \text{(C)}$$

This is, of course, the familiar formula for any Fibonacci number.

Now, examining that formula for successive values of f(i) for successive values of i (mod 10) is non-trivial, to say the least. We can transform (C) into an interesting series form by applying Newton's binomial expansion formula and collecting terms--luckily all the radicals drop out--and we get:

$$f(i) = \frac{1}{2^{i-1}}\left[\binom{i}{1} + \binom{i}{3}\cdot 5 + \binom{i}{5}\cdot 5^2 + \cdots + \binom{i}{2m+1}\cdot 5^m + \cdots\right] \qquad (D)$$

where the bracketed terms end when 2m+1 is greater than i, and the $\binom{i}{k}$ are the alternate terms in any row of Pascal's triangle, and can also be written

$$\binom{i}{k} = \frac{i!}{k!(i-k)!} \quad \text{as usual.}$$

We can verify formula (D) for $i = 12$ ($m = 5$), and we will find, of course, that F_{12} is 144, as is already known.

Now, let us begin to study this formula for its behavior (mod 10) as a series on i. First let us note that

$$5^k \equiv 5 \pmod{10}$$

so we can drop all terms containing higher powers than the first in 5. We then have:

$$f(i) = \frac{1}{2^{i-1}}\left[\binom{i}{1} + 5\left\{\binom{i}{3} + \binom{i}{5} + \cdots + \binom{i}{i-1}\right\}\right] \pmod{10} \qquad (E)$$

recognizing the bracketed terms as being, <u>almost</u>, every other term in any line of Pascal's triangle, and, since we know that

$$\sum_{j=1}^{i}\binom{i}{j} = 2^i$$

then the bracketed terms are

$$\left[2^{i-1} - \binom{i}{1}\right]$$

We note that $\binom{i}{1} = i$, and we can write (E) as:

$$f(i) = \frac{1}{2^{i-1}}\left[i + 5(2^{i-1} - i)\right] \pmod{10}$$

$$f(i) = 5 - \frac{i}{2^{i-3}} \pmod{10} \qquad (F)$$

We have reduced the original problem to a somewhat simpler form and we could now study (F) for the series of digits and look for its repetition cycle. This is still a fairly formidable task and one concludes that this is not the way to go. We would, eventually, find the F_1 cycle of 60, but an empirical study is much more fruitful. Suffice it to say, exploring the sequence of digits for the solution to the 3-column case by the above approach would be difficult, even if we wrote down the solution to (A).

One final observation might be useful. The 3-column case yields:

$$a_i = a_{i-1} + 3a_{i-2} + 3a_{i-3} + a_{i-4},$$

and the 4-column case yields:

$$a_i = a_{i-1} + 4a_{i-2} + 6a_{i-3} + 4a_{i-4} + a_{i-5},$$

and so on; that is, for the K-column case, simply copy the Kth row of Pascal's triangle for the coefficients of the K+1 terms on the right:

$$a_i = a_{i-1} + \binom{K}{1} a_{i-2} + \binom{K}{2} a_{i-3} + \cdots + \binom{K}{j} a_{i-j-1} + \cdots + \binom{K}{K} a_{i-K-1}$$

All these forms are homogeneous linear difference equations with constant coefficients and all have solutions expressable in series. Not easy, though!

~~The list of guidelines on the facing page evolved over many years in response to pleas from friends for help in getting a child through the first year of algebra. It seems ot~~

The list of guidelines on the facing page evolved over many years in response to pleas from friends for help in getting a child through the first year of algebra. It seems to have been of some help. The usual response to it has been "Why doesn't the text--and the teacher--tell the student such things?"

Guidelines for Algebra Problems

1. Most problems begin with the word "Let." In other words, you should state what the variables are, and the units they are in. For example, "Let X = the amount of anti-freeze, in quarts."

2. Check your results. They must satisfy the equations, and have the proper units.

3. Then check for reasonableness. Trains don't usually travel at 800 miles per hour, or at 2 miles per hour.

4. Label your answers and your figures.

5. Draw lots of figures. You must have noticed that your teacher does this all the time, at the board.

6. If in doubt about what to do with a complicated problem, make up a simpler problem that you can solve; then ask yourself how you solved it; and then generalize to the original problem. This is the most powerful tool you can use.

For example: There are 23 volumes on a shelf, numbered consecutively from 17 through 39 (quick--check that); what is the number of the middle volume? Try first a simpler situation, where there are 3 volumes, numbered from 33 to 35. Figure out how you can get the number 34 from the given numbers. Try your method with 5 volumes, to check that it still works; that is, that it will generalize. Now extend the method to the original problem.

7. Do what the problem asks for; that is, solve the problem given to you, and not some other problem that you like better. The rule is: give the man what he asked for.

8. Don't skimp on paper--spread it out. Someone has to read what you write. Make it clear. Show your arithmetic, off to the side.

9. Don't hesitate to state your assumptions and your reasoning.

10. Do the easy problems first; that is, do first the problems you find easy.

11. Write in English, and tell no lies. If you calculated the answer in yards and got 17, but then you remember that the problem asked for the result in feet, don't write 17 = 51, because it isn't true.

12. Generally, something is better than nothing. A blank sheet is always worth zero. A sheet with something on it may still be worth zero, but it is harder for your teacher to assign that value.

13. Cancel only factors, not terms (and make sure that you know the difference between those two things). The fraction 26/65 could be reduced to lowest terms by cancelling the 6's, but it's not good form. Add only similar things; you can't add apples and oranges. In other words, every term in an equation must be in the same units. But notice that you can multiply feet and pounds, and the resulting units are foot-pounds.

14. Don't try to divide by zero; it's not legal.

15. The essence of algebra, for most problems, is the assumption that we know the answer to the extent that we can call it X. Then we set up enough conditions on that X to lead to an equation that we can solve. When in doubt how to plunge into a new problem, try doing something. Could the required result, X, be 1,000,000? No? Why not? Could X be -17? Well, what could it be? In other words, try playing with the conditions of the problem, to acquire insight into its workings.

In issue No. 4, Timothy Croy's calculation of the exact value of (10000!) was reported. Part of that result is

$$2.846259680917054518906413212 11 \times 10^{35659}$$

How would this compare with adding the logarithms of the numbers from 1 to 10000? Using 12-place logs, the sum is

35659.4542396

whose antilog yields

2.8460308.

Thus, this approach produces the correct number of digits and the correct value of the first four digits. The calculation by summing the logs was extended, to produce these results:

10000	35659.4542396
12000	43741.0798081
14000	51968.1418542
16000	60319.7090991
18000	68780.1310706
20000	77337.2597967
22000	85981.3905835

Thus, it is not unreasonable to expect (22000!) to have 85982 digits, if the exact value is ever calculated. □

In issue 43, the results of Contest 7 (The K-Level Sieve) were reported. The winners, Tom Duff and Hugh Redelmeier of the University of Toronto, calculated the first 1199 terms of the sequence. For selected values among the first 1199 terms we have:

Term No.	No. of digits	Ratio
42	14	3.000
100	32	3.125
300	93	3.226
500	153	3.268
1000	304	3.289
1199	364	3.294

Duff and Redelmaier have now extended their calculation to the 32768th term so that the table above can now have added to it:

32768	9869	3.320

Book Review

THE MIND TOOL
by Neill Graham
West Publishing Company, 1976, 263 pages, $8.95.

This is a book for the course Survey of Digital Computing, given on any campus for non-computer-science majors. It is also a nice book to recommend to friends and relatives who are curious about your work, but not too curious. The treatment is light.

In the Preface, the author points out "Both the 'technology hater' and the 'technology worshiper' do society a disservice: The first would deny us the often substantial benefits of technology, whereas the second would fail to warn us of its possible dangers." So far so good.

But with the first sentence of the book ("A computer is a machine that processes information.") things start to go awry. That definition embraces pocket calculators (and the author explicitly includes them as computers), but also includes gas pumps, arithmometers, typewriters, and who knows what. One might suspect that the author is not a computer man. That opinion would get reinforced on reading that "An algorithm is a program stated in general terms rather than in terms of instructions for a particular computer."

Despite this obvious lack of expertise or sophistication, the book might be useful. Your Aunt Nellie might not really care what an algorithm is; she might be content to know that there are such things, and that computing uses them. The reader will get a quick overview of the role of computers in society: in game playing, simulation, vote-counting, traffic control, crime prevention and detection, and the arts. The copious references might encourage the reader to consult books and articles that are written by experts. There is little in the book that is out-and-out wrong; it is simply shallow and superficial.

But then, perhaps our industry needs some of this treatment; the experts have done a poor job of selling computing to the public properly. □

CONTEST 8 RESULTS

Our 8th contest (OUTGUESS) appeared in issue No. 39. Contestants were invited to submit a set of nine 3-digit numbers, together with the mean and standard deviation of the set, and the product of the mean and standard deviation. The mean, standard deviation, and product were calculated for all the sets of numbers submitted, and the winner:

Donald Swiertz
Milwaukee, Wisconsin

had the product that came closest. The figures are:

		Mr. Swiertz's set of numbers	
		143	
		426	
total mean	522.7435897	358	494.78
total		921	
standard		866	
deviation	267.7385315	223	281.176
		510	
Product	139958.6011 ←	717	→ 139119.638
		289	

N-SERIES 44

Log 44	1.6434526764861874311776777606920102952430819533390670
ln 44	3.784189633918261162896407820881482435972707122657928
$\sqrt{44}$	6.633249580710799698229865473341373367854177091178707
$\sqrt[3]{44}$	3.530348335326063002195972592848295304340726566474216
$\sqrt[10]{44}$	1.459974490623363079036659497407152428611916606389697
$\sqrt[100]{44}$	1.038567018649751713158923557183689424736418861051297
e^{44}	12851600114359308275.80929963214309925780114322075882 58719200294925193304731530524176
π^{44}	7491941861682291566352.553887054985308222022098822761 178025255680325173769351665994
$\tan^{-1} 44$	1.548072965953255553933173895774600775881788879614650

Indeces for 10th and 100th root were inadvertently left off N-Series 43.